P09

Statistics of radioactive decay

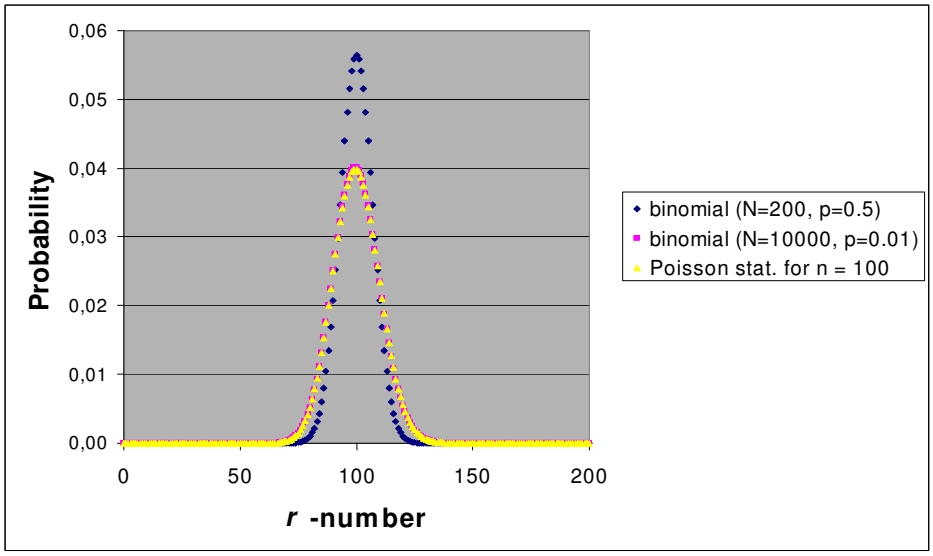
Servo Kasi

Helsinki University, Helsinki, Finland

Exponentially decaying radioactive nuclides obey binomial or Bernoulli stochastic law [1,2,3]. From the number N of a certain nuclide (with the half life $T_{½}$) in the time T the number of radioactive disintegrations $n = N \exp[-\ln(2)\ T/T_{½}]$.

The probability $p = \exp[-\ln(2)\ T/T_{½}]$ has been set for the disintegration of any nuclide in the time T. Then n is the mean (i.e. Expectation) value from the binomial distribution law for the stochastic variable r of the number of disintegrations.

When $T << T_{½}$, i.e., pN is constant -- in practice, then the Poisson stochastic law is applicable, and $n = E(r)$, r the stochastic variable. The variance of the Poisson distribution is larger. The Bayessian approach is reviewed.



Today the binomial and Poisson distributions can be calculated as easily. The error estimates Δn and $\Delta n/n$ are presented. Times T, so that n has those errors, e.g., for that $\Delta n = 1$, are presented.

Consideration: of the ways of the background forming, the background reduction and the optimal measuring times, is presented.

[1] Rainwater, L.J.; Wu, C.S., *Nucleonics* **1** (1947), October, 60-69.

[2] Gol'danskii, V.I.; Kutsenko, A.V.; Podgoretskii, M.I. (В.И. Гольданский, А.В. Куценко, М.И. Подгорецкий), in Russian: Статистика отсчетов при регистрации ядерных частиц, М.: Физматгиз, 1959.

[3] Stevenson PC. 1966. "Processing of Counting Data," NAS-NS-3109, Livermore, California, National Academy of Sciences -- National Research Council. Nuclear Science Series, Radiochemical Techniques.